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Sequential exercises and Personal Response System in project management courses

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Abstract

Large classes are becoming a common feature of higher education. Although the dynamics of these classes are very different from smaller classes, the learning principles are still the same. Active learning and students' engagement provide better learning outcomes. There are strategies developed to overcome the limitations of large classes. This paper presents the result of the implementation of two teaching strategies – guided sequential exercises, and collection of instantaneous student responses. The student responses were collected through a Personal Response System (PRS). The strategies have been implemented in a large project management class. The student feedbacks have been used to investigate the effectiveness of these strategies. 323 students participated in formal surveys over four years. The results of these surveys showed that they found the teaching method very effective and the learning experience very interesting. They believed the best aspect of the course was the lecture and its interactive nature. The paper demonstrates how a conventional setting of lecture delivery can be transcended to a pleasant and effective learning experience. The sequential exercises and Personal Response System articulated in the paper can be adopted in other technical courses.

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Keywords: interactive lecture; active learning; personal response system, project management.;

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1. Introduction

Active learning engages higher cognitive process in students. Students are involved in question, reasoning, organising and interacting within the subject context. This interactivity makes the learning process more enjoyable by addressing and harnessing the students' attention span. On a more deeper level, the interactive lectures substantially enhance the students' learning (Bates, Howie, & Murphy, 2006). Having discussions, engaging with students, and giving and receiving feedback in small classes is possible through one on one interaction. However, creating this engaging environment is a challenge in large classes.

Undergraduate classes are growing in size. The large classes are more common in foundation studies and the courses common between different majors. In these large classes, the lecture is the mainstream format for delivering course material. Students also ex Introduction

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Undergraduate classes are growing in size. The large classes are more common in foundation studies and the courses common between different majors. In these large classes, the lecture is the mainstream format for delivering course material. Students also expect to receive the material through formal lectures. The lecturer in this system is the centre of attention and is responsible for transferring knowledge to students. However, there is well established evidence that one way communication in the lecture setting does not result in good learning outcomes (Gysbers, Johnston, Hancock, & Denyer, 2011). Students retain only a small percentage of the learning material.

In this setting, there are technologies developed that make the real time feedback possible and create an engaging environment for learners. One of these technologies is Personal Response System (PRS) also known as Clickers or Electronic Voting System (EVS). PRS has primarily been adopted to enhance the learning experience. It has been used in different contexts and subject areas (Liu & Taylor, 2013; Masikunas, Panayiotidis, & Burke, 2007; Moss & Crowley, 2011; Voelkel & Bennett, 2014; Wolter, Lundeberg, Kang, & Herreid, 2011).

There is a growing demand for project management courses. The number of undergraduate and postgraduate students studying project management is increasing. There is also a demand from other majors such as engineering and business in which students are suggested to undertake courses in project management as their electives. The case study course in this paper is a first year undergraduate course in project management that is common between different programs and therefore involves a large cohort of students. The course is called Project Management Techniques.

This paper presents the implementation of principles of active learning in a large lecture hall through sequential exercises and Personal Response System (PRS) in delivery of this course. The following sections provide a background into the implementation of these teaching strategies and their results.

2. Background

The Project Management (PM) Techniques course is a first year undergraduate course common between three different programs - Project Management, Construction Management, Property and Valuation. The course is delivered through weekly lectures and tutorials. Each week is dedicated to a particular PM technique such as project selection methods, Bar Chart, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), cash flow management, and Earned Value analysis.

These techniques are mathematical methods that need to be learnt through practice. Listening to the theories would not lead to learning and proficiency. Students need to engage with the course content and practice what they hear from the lecturer. Further, most of these techniques are step-by-step processes. Students learn the process by going through the steps. If a step is missed, the following steps are incomprehensible. Therefore the lecturer needs to make sure all students are taking the steps and there is no confusion in each step before moving on to the next step.

For example, implementation of Critical Path Methods needs three steps:

1. Drawing project activity network
2. Calculation of early start and finish dates of activities through forward pass
3. Calculation of late start and finish dates of activities through backward pass

A project manager cannot undertake the third step without going through the previous steps. Similarly, students cannot practice and learn the third step without learning and practicing the previous steps. Therefore it is imperative that students learn the techniques through replicating and practicing the sequential steps.

There are two major challenges in delivery of this course. First, since this course is a common course between three different undergraduate programs, the student cohort is large and it has reached to 300 students in some semesters. The step-by-step PM processes require students' engagement throughout the lecture while the short attention span makes this continuous engagement difficult. Keeping a large cohort of first year students fully engaged is a major challenge.

Secondly, the PM techniques are numerical techniques. This cohort generally are not adequately skilled in mathematic. Any confusion and vagueness in lecture would distract their attention. They would not follow the lecture after that point.

3. Implementation

Meltzer and Manivannan (2002) suggest that there are two key strategies to create an interactive lecture. First strategy is to provide a deliberate step-by-step guidance for students to think about, discuss, and respond to a carefully designed sequence of questions and exercises. The second strategy is the provision of a system that collects instantaneous responses from students in class simultaneously.

Both strategies have been implemented in this course. Each lecture is divided to smaller sections that correspond with each step of undertaking a PM technique. The lecturer explains the step and demonstrates a practical example of that step, then students are asked to practice that step on a specific problem given to them. Students are given a limited amount of time to work on that section and reach the solution. Figure 1 demonstrates one of these class activities.

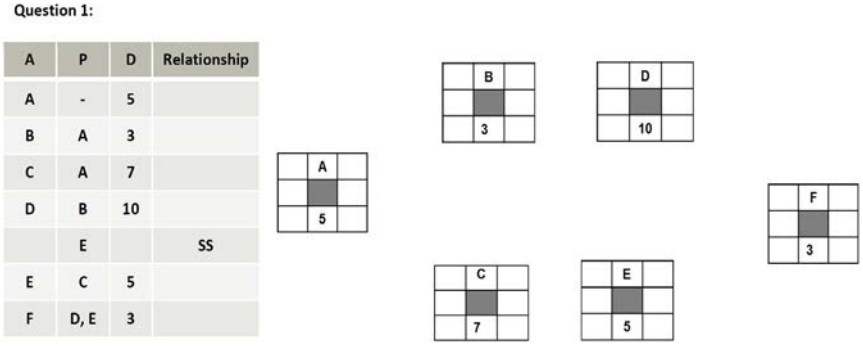

Figure 1. An example of a class activity in project management techniques

In this example, each box represents a project activity. Students are asked to draw the correct project network and figure out the correct activity dates by going through the Critical Path Method steps mentioned in the previous section. Then they are asked to enter their answers into the Personal Response System.

Collection of instantaneous responses is the second strategy that is implemented through an online polling system. The online polling system used in this course is developed in TurningPoint software (www.turningtechnologies.com), and responses are collected through ResposeWare (www.rwpoll.com), which is an online platform. This platform is accessible via any device that can connect to the Internet. The use of ResponsWare is extremely successful because of the familiarity of students with their devices, and using their mobile devices satisfies their craving for checking their mobiles. The results of each poll are shown to the students in real time in graphs.

Figure 2 shows a sample of polling results. As can be seen in this figure, the graph shows a variety of answers. The demonstration of the variation in answers helps students to have a debate in the class. It also shows them there are other students who think similarly to them and make them part of the team.

Figure 2. A sample of ResponseWare results

The use of *other* option is crucial in this polling. The *other* option plays two roles. It allows students who could not arrive at any other option to participate in the poll. It also allows students who struggle in starting to deal with the problem and are stuck without a clue to communicate their issues with the instructor.

The real time feedback has benefits for students and lecturer. The students can see the correct answer. They can compare themselves with their peers. They can see others making mistakes. This practice shows the importance of learning the process than only focusing on the final answer. Further, because students are working on a problem and are undertaking an activity, the flow of the lecture is interrupted and they feel they had a break.

Lecturer of the course also benefits from these polls. The results of the poll demonstrate the muddy points and the lecturer can spend more time on those points. The poll helps the lecturer to efficiently manage the lecture time. The poll breaks the monotonous lecture setting and makes the learning environment more engaging. In addition, there is time available to the lecturer and students during the polls for one on one interaction.

4. Student feedback

The University conducts formal student surveys at the end of each semester. These surveys are independently administered, anonymous, and voluntary. The student feedbacks are collected and reported in two formats of quantitative scoring and qualitative feedback. Over four years from 2012 to 2015, 323 responses have been collected. The results of these surveys are used in this paper to demonstrate the effectiveness of the teaching method.

The two strategies of guided sequential problem solving and collection of instantaneous responses have been gradually introduced to the Project Management Techniques course over five semesters. At the middle of 2012 semester two, the sequential problems were introduced to the course. The collection of real time student responses was implemented in 2014.

Figure 3 demonstrates the students' feedback on the statement *the teaching staff are extremely good in explaining things*. The graph reports the percentage of agreement with the statement.

As can be seen in this figure, there is a very high percentage of students believing the course has been delivered efficiently and students found the lecturer good in explaining the subject. This is the result of the sequential problem solving. The lecturer makes sure that students are engaged and guided through the lecture material.

This percentage has grown from 2012 and steadied since 2014, which is the result of introduction of sequential problem solving during the class.

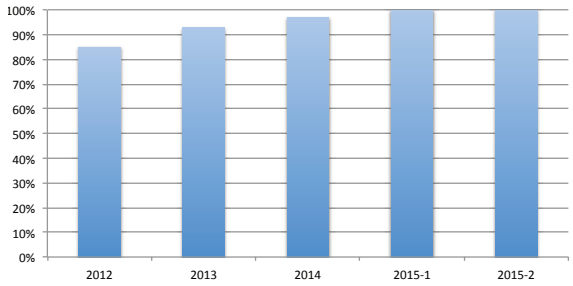

Figure 3. The percentage of agreement with ‘the teaching staff are extremely good in explaining things’

The next graph demonstrates the percentage of agreement with the statement ‘the teaching staff work hard to make this course interesting’. The joy in attending the class comes from participation in learning activities. Since students are engaged in the learning activities through the Personal Response System, they find the learning process interesting. Figure 4 demonstrates the percentage of agreement with that statement.

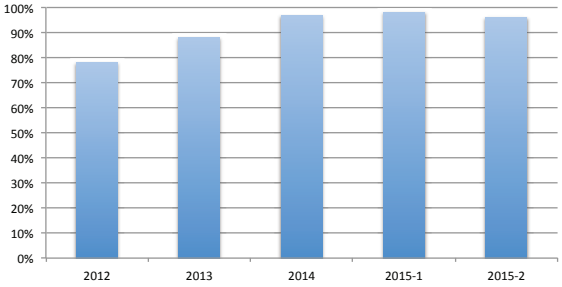

Figure 4. The percentage of agreement with ‘the teaching staff work hard to make this course interesting’

The qualitative feedbacks are provided by the students in the response to the question ‘what are the best aspects of the course?’ Figure 5 visually demonstrates a word cloud of 323 student responses.

Figure 5. The word cloud of students’ opinions on the best aspect of the course

As can be seen in this figure, the best aspect of the course mentioned by the students is the lecture. While the lecture setting in conventional teaching methods is a one-way communication between lecturer and the students and is always criticised as an ineffective way of learning and teaching. The interactive teaching method in PM

Techniques course made the lecture the best part of the students' learning experience. The second standout word in the students' feedback is 'interactive'. Students believed that the interactive delivery made the course more interesting.

Here are some examples of the students' statements indicating the best aspects of the course.

'The lectures are very interactive with the use of ResponseWare. This furthers the learning of everyone in the class and allows us to know whether we are doing the activities correctly before we do the weekly activities.'

'It is obvious that there was a substantial amount of time and effort put into this course and it definitely showed as the lecturers interaction with the students was exceptional.

Understanding all the information was made easy with interactive lectures and tutorial activities; the weekly exercises with speedy feedback was also fantastic.

Reponseware was a nice touch on audience engagement and the lecturer provided excellent encouragement to students.'

5. Conclusions

Large classes are becoming more common in higher education. Project management courses are no exception. Lecture setting is still the main mode of delivery expected by the students. However, the conventional lectures in which the lecturer is at the centre of attention and communication is one way do not provide the best learning experience. Active learning and interactive lectures are suggested strategies to overcome the limitations of large lecture halls.

This paper presented the results of implementation of sequential class exercises and the use of Personal Response System in a large project management course. The implementation of these strategies has been explained. The student feedback over four years has demonstrated the effectiveness of these strategies. Students found the teaching method very effective and the learning process very interesting and enjoyable. They believed the best aspect of the course was the lectures and their interactive nature.

The paper demonstrates the importance of active learning and the effective strategies to create an environment in which active learning can take place. Although the paper is focused on a project management course, similar technical courses can also use these strategies to enhance students' learning.

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